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Skipjack Tuna (K. pelamis, L.) Resource in the Seas Around Ceylon

By

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INTRODUCTION

With the overall decline in the abundance of the deepswimming components of the tuna stock in the three Oceans, attention of tuna fishing nations has shifted to the under-exploited resources of skipjack tuna and the surface swimming components of the larger tunas. Hence, there is a rapid expansion in the fishing methods such as purse seining and live-bait fishery, particularly in the Pacific and Atlantic Oceans. In the Indian Ocean, trolling, drift netting and pole and line fishing methods contribute to the exploitation of the skipjack tuna. Purse seining for tunas in the Indian Ocean has not received encouragement. Though the pole and line method has been practised over half a century, in many of the islands including Ceylon, this fishery still continues to be operated in the primitive way, without any noteworthy innovation (Author 1965).

Execution of the present plan for the development of Fisheries in Ceylon envisages expansion of the pole and line method along modern lines. The increase in the production of skipjack tuna in Ceylon over the last five years ' has been almost entirely due to the development of drift net fishery. There are certain drawbacks in developing this Drift net fishery on a much bigger scale and hence the stress has been placed on developing the pole and line method.

Source and Processing of Data

The source of material, sampling technique and methods of analysis are as described earlier by the Author (1965 and 1971). The catch per operation or per fishing tiip, not exceeding twenty-four hours, has been taken as the catch rate for each class of vessel or craft operating any particular fishing gear. Approximately thirty 11 Ton class drift netters, one thousand and twenty $3\frac{1}{2}$ Ton class of versatile boats are engaged in fishing methods producing tuna and tuna like fishes. In addition, there are approximately nine hundred out-rigger canoes (oru) conducting trolling for tuna, irregularly. About three hundred and fifty of these large sized out-rigger canoes are engaged in pole and line fishery for skipjack tuna in the South-West region, between November and April and on the East Coast, between June and October. However due to the problem of availability of live bait (*Dipterygonotus leucogrammicus* Bleeker) and the time consumed in searching and collecting the live bait, the traditional crafts average only about nine or ten days of active fishing per month, during these two seasons. Though a number of the $3\frac{1}{2}$ Ton class of vessels also take up to pole and line fishing during the same time, it is not as regular as the operation by the traditional crafts. The efficiency of the pole and line operations by traditional Out-rigger Canoe is relatively high and the catch made by this class of traditional crafts adds significant weightage to the production of Skipjack tuna in Ceylon. Hence, in the present study, the effort by the traditional Craft conducting pole and line fishery and the effort by $3\frac{1}{2}$ Ton mechanised boats conducting trolling, drift netting as well as pole and line fishng have been standardised at the level of the $3\frac{1}{2}$ Ton drift netters, using efficiency factors (Table 1).

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The distribution of fishing effort (number of fishing operations) for each type of fishery, was estimated by utilising the sampling for the fishery effort through different gears used for capturing blood fish and the data on distribution of vessels and crafts and the average number of fishing days for each month, within each area. The production figure was estimated by using the catch rates for each type of fishery according to area, with the corresponding estimates of effort. The effciency factors were determined from the samplings for catch rates for each type of fishery according to area. Unlike in an earlier case (Author 1971), mean efficiency factors were determined and applied, instead of a laborious process of determining efficiency factors for each year, separately. It must be accepted that these estimates have been made without weightage to many variables and hence the results have been used only for observing trends and not for any absolute determination. However detailed and complete statistics of the fishing effort and catches by varieties are available for the small fleet of 11 Ton class of vessels and these have been analysed separately and used for checking the reliability of the results of the other classes.

Data on the tuna longline operations in the Indian Ocean published by the Fisheries Agency of Japan and the data of the Ceylon Fisheries Corporation tuna vessel operation, were also made use of in determining the catch rates of skipjack tuna, hooked incidentally on the tuna longline.

Area	N. N. West	N. West	West	S. West	South	East and N. East	N. N. East	Efficiency Factor
11 Ton Drift Net	6·7	154·8	311·6	280·9	254·3	132·7	30·0	2·36
3½ Ton Drift Net	–	58·9	143·4	89·0	115·7	69·8	*	1
3½ T. Pole and Line ..	–	–	*	178·6	176·5	105·0	–	1·73
3½ T. Troll	*	*	17·6	27·3	22·8	13·9	*	0·20
Oru Pole and Line	–	–	92·3	140·4	127·6	87·7	–	1·14

TABLE I

Mean catch rates (1967–1971) for Skipjack tuna (in lbs.) caught in various areas by different types of fishery directed on blood fish varieties

(* = Insufficient sampling ; — = Fishery not conducted)

Mixed Fishery

There are mainly four varieties of blood fish entering the catches from the seas around Ceylon and except for the pole and line fishery, none of the other methods could be considered as effort directed specifically on any one variety. The variations in the percentage composition due to the selectivity of the gears and the fishing area have already been discussed (author 1968 and 1971). In the trolling line, drift net and pole and line fisheries, skipjack tuna forms approximately 27%, 55% and 87% of the blood fish catches, respectively. The areas around Ceylon where the different methods of fishing contribute to the production of skipjack tuna, are shown in figure 1. Pure schools of skipjack appear seasonally but often they are in association with young yellowfin tuna, mackerel tuna and even frigate mackeral. The number of these varieties in the mixed schools is dependant on the mean length of fish in the school (Author 1968).

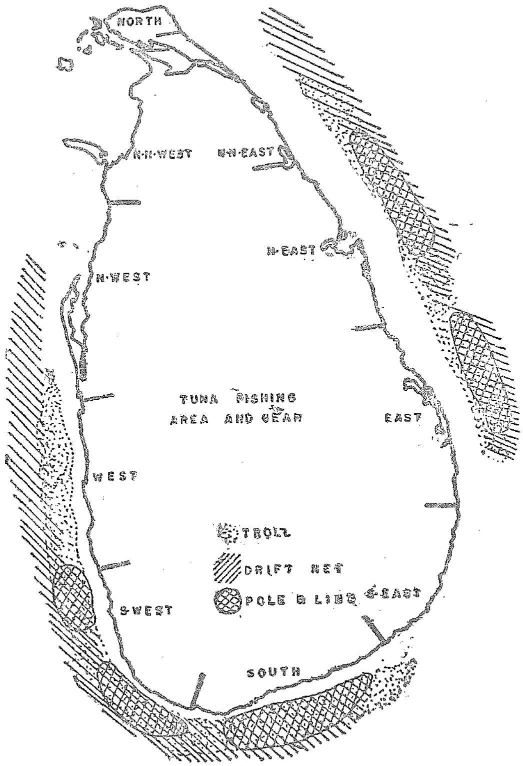


Fig. 1.Map showing skipjack tuna fishing areas and the gears through which effort is directed.

Size Composition

The size range of skipjack entering the surface and subsurface fisheries around Ceylon, is 30–78 cm. and the frequency distribution is polymodal. A graphical analysis of the polymodal frequency distribution, using the probability paper method (Harding 1949 ; Cassie 1954) was attempted. The results indicated the possiblity of having five modes at 34.2, 43.0, 52.4, 63.0 and 71.5 cm. levels, for skipjack caught during 1970 (Fig. 2). The first modal group occurs commonly in the troll catches from the South West and East Coasts (Fig. 3). The second, fourth and fifth modal groups, though appearing in all areas around Ceylon, were conspicious in the ' North-West ' and ' East ' areas. The third modal group is the most significant group in the catches from the ' West ', ' South West ' and ' South ' areas (Fig. 3). Since the introduction of drift net fishing, around 1968, significant quantities of the fourth and fifth modal groups enter the catches and in 1971 a large percentage of the catches were of the fourth modal group (Fig. 4). The troll fishery is a year round fishery but only the smaller skipjack (1st and 2nd modal groups) are more vulnerable to this fishery. The pole and line fishery is limited to the periods, November to March in the South West region and July to September on the East coast. Hence the size composition available to these two fisheries are limited by seasonal and vulnerability factors. The drift net is a highly selective gear but the use of wide range of mesh size (4″–6″) results in the sampling of fairly wide length range. However, a fair amount of the third modal group and almost the entire fourth and fifth modal groups are not effectively gilled in the driftnets and hence the efficiency of the drift nets in use, decreases beyond the third modal group. Therefore it cannot be taken for granted that this gear is making a proper sampling of the population. The mesh sizes would determine the position of the mode in the catches. The length compositions obtained for the years prior to and subsequent to the introduction of drift net fishery for skipjack, do not indicate drastic shift in the position of the mode, except that inspite of the limitation of the mesh size the driftnets bring in a relatively larger proportion of the fourth and fifth modal groups than the trolling lines or pole and line fisheries. The trolling lines and pole and lines do not have selective power for size of skipjack at the surface. The skipjack between 45–50 cm. are generally mature and a large quantity of skipjack of this size range entering the pole and line fishery off the South West region, between November and March, were mainly spent females (Author 1965).

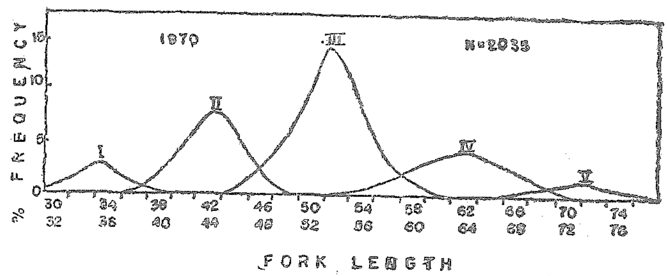


Fig. 2. Graphical analysis of polymodal distribution of the length frequency of skipjack caught around Ceylon (1970), using probability paper.

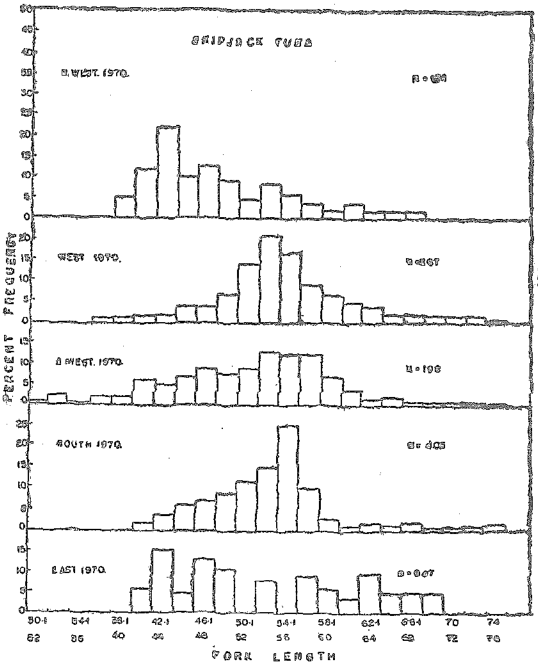


Fig. 3. Length frequency distribution for skipjack caught in different areas, in 1970

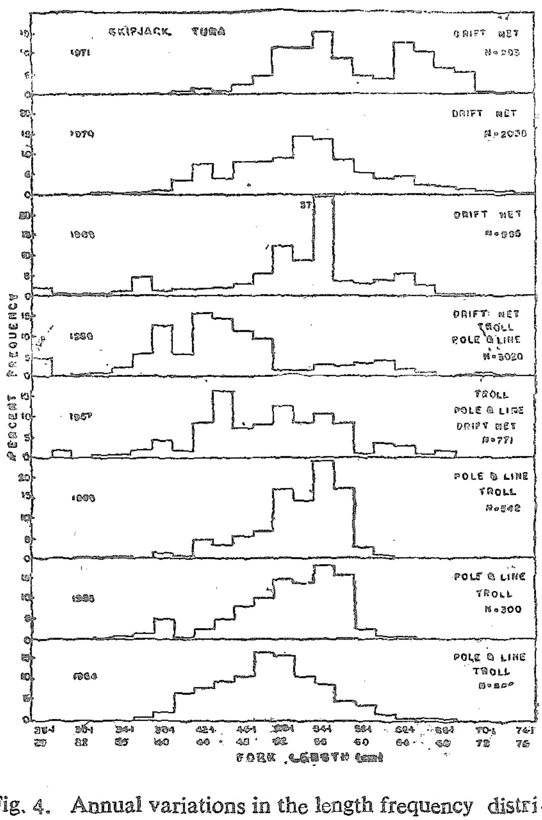


Fig. 4. Annual variations in the length frequency distribution of skipjack caught around Ceylon.

Seasonal Variation in Occurrence

Until the introduction of drift net method of catching tunas, skipjack tuna was caught during June to August and November to March in the South West region and from July to September on the East coast. The trolling method exploited chiefly the first entry group (1st and 2nd modal groups) moving into the inshore range mainly during the South West monsoon (June to August) and also made sporadic catches of larger skipjack during the rest of the year. The pole and line method of fishing is limited by seasons of availability of the red bait (*Dipterygonotus leucogrammicus* Bleeker) which alone survives the crude system of live bait handling. The live bait fishery is very successful between December and February and quite often the 3½ Ton vessel would bring in over two thousand pounds of skipjack in less than twelve hours. During this season schools of skipjack move into the inshore range and become easily exploitable. Very large percentage of the catch consisted of spent females between 45 and 50 cm. The pole and line fishery on the East Coast, between July and September has not been as successful as that in the South West region.

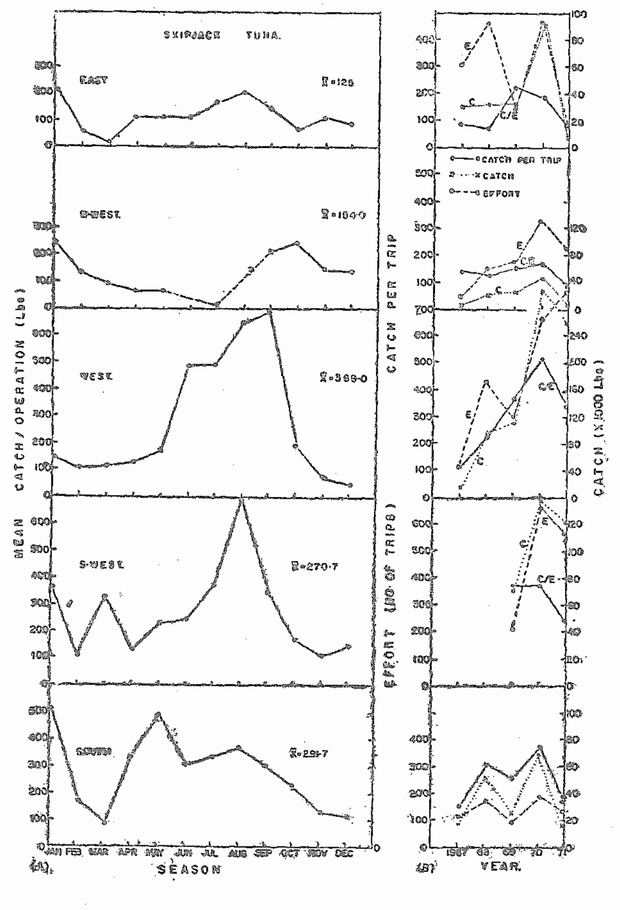


Fig. 5. (a) Average year's (1967–1971) seasonal variation in the mean catch rate of skipjack by 11 Ton Drift netters and (b) annual variation in the skipjack fishing trends, in the different areas

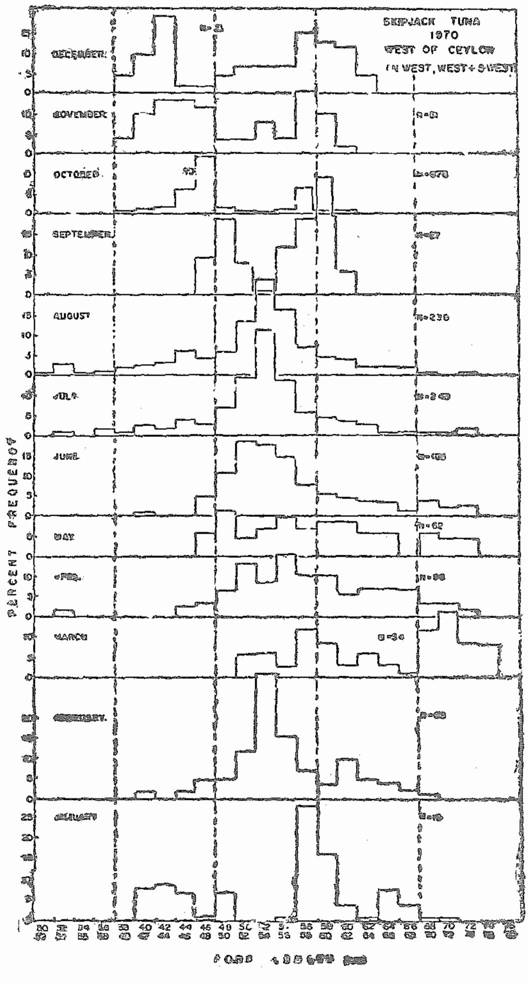


Fig. 6. Seasonal variation in the length frequency distribution of skipjack caught off the Western region of Ceylon (1970)

Introduction of the 11 ton class of drift netters and rapid development of drift net fishery for tunas by the $3\frac{1}{2}$ Ton class of vessels, resulted in the decline in the popularity of pole and line and trolling methods. Further the range covered by the fishery also expanded to cover fringes of the offshore range just outside the in-shore range. These resulted in achieving a rise in the level of year-round production of skipjack with new and very high peak seasons (Fig. 5). In the ' South ', ' South West ' and ' East ' the good catch rate around the beginning of the year may probably correspond to the good catches of spent females which were exploited earlier by the pole and line method. The main peak catch rate is during the South West Monsoon. There are indications of slight variation in the peak period according to the area—May in the ' South ' ; August in the ' S. West ' ; September in the ' West ' and October in the ' N. West ' (Fig. 5). In the ' East ' though there are evidences of peaks, the seasonal variability is not so marked as in the South or West Coasts and the catch rate level is relatively lower than in the other coasts. In the ' N. West ' fishing is suspended between May and September, due to unfavourable weather conditions of the South West monsoon.

The seasonal variation in the size composition (Fig. 6) shows that recruitment to the exploitable stock in the water around Ceylon may be occurring irregularly throughout the year with a peak around the middle of the year (third quarter). The catch during the best fishing season consists mainly of the third modal group. During the fourth quarter when the catch rate rapidly declines, the third modal group becomes reduced and the second modal group and partly the fourth modal group become prominent. In the first quarter of the following year the size composition shifts into the third and fourth modal groups and by the end of the first quarter, the fifth modal group also appears but the catch rate becomes very poor. During the second quarter, third fourth and fifth modal groups become equally represented but the catches rate continues to decline. On entering the South West monsoon (third quarter) the catch rate increases with the third modal group rapidly gaining dominance while the fourth and particularly the fifth modal groups disappear rapidly from the catches.

Abundance

As discussed in the preceeding section, the skipjack tuna moves into the inshore water seasonally. The first entry groups moves into the inshore range mainly during the South West monsoon and actively feeding pure schools of skipjack moves into the inshoıe range during the period, November to March. Except for these migrants, there may be an extremely sparse resident stock contributing to the sporadic catches in this range. The resources in the outer fringes of the range and the adjacent areas of the off shore range contribute significantly to skipjack production in Ceylon.

Even in this belt the abundance may be greater than in the inshore range but availability to the drift net method is yet seasonal. The mean catch rates determined for various categories of vessels and crafts operating in different areas around Ceylon are given in table I and illustrated in figure 7. The highest catch rates have been realised in the ' West '. South of this area, the catch rate showed a very small rate of decline but North of ' West ' the value showed a rapid rate of decline. The catch rate on the ' East ' Coast was almost half that observed for the ' West ' but the rate of decline toward the ' N. N. East ' was much less. The catch rates for the ' North ' and ' N. N. West ' areas were negligible and sporadic.

In the absence of reliable statistics on the production of skipjack in Ceylon, the effort and catches were estimated as explained in an earlier section. Such a method of estimation is approximate and exclusion of a number of variables has resulted in the reduction of normal fluctuations in the values and hence, fairly smooth ones have been obtained (Fig. 8). This analysis has been attempted to note the trend in the annual variation of effort, catch and catch per unit of effort. The data for the 11 Ton class for which reliable statistics are available, have been plotted separately (Fig. 8) for comparison of the trends in the two cases. The results indicate that the introduction of drift nets resulted in the increase in the production of skipjack tuna by almost three hundred per cent. without a very significant increase in the number of vessels and number of operations. As a result of this progress, skipjack is one variety for which there has been a marked drop in price in the local market. Last year (1971) the 11 Ton of vessels showed a decline in the overall catch rate (Fig. 8) as well as in the class rates for all areas (Fig. 5 B). The decline in the effort was due to frequent break down of the vessels

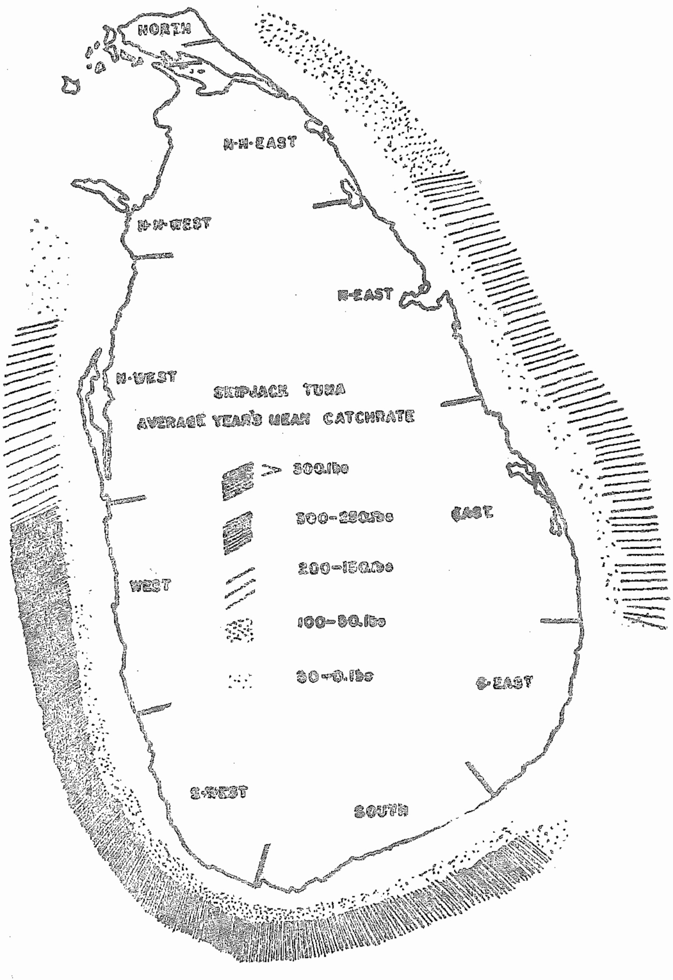
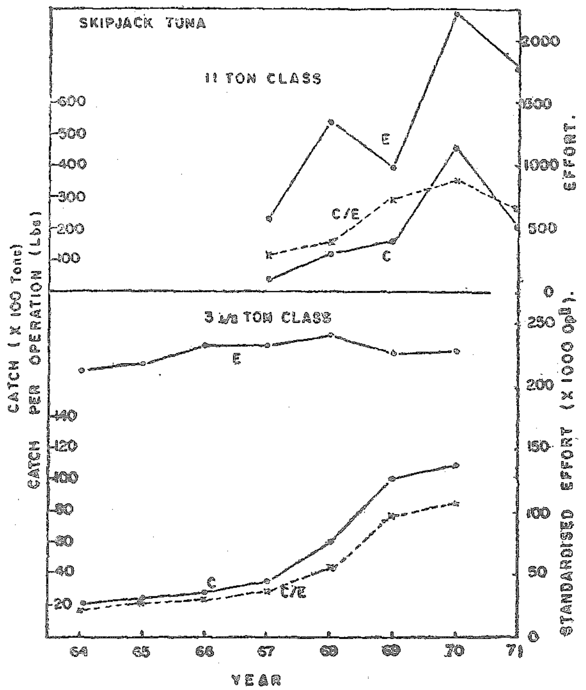


Fig 7. Average years catch rates (1964–1971) for skipjack, in the areas around Ceylon



Fgi. 8. Annual variation in the Catch, effort and catch rates for skipjack caught by 11 Ton class and other classes standardised to 3½ Ton Drift netters.

and the decline in the catch rate is attributed to the significant reduction in the number of units of drift nets used in a set, as a result of damage and loss at sea. There is a possibility that natural fluctuation also may have been an additional factor, because of relatively poor catches of second and third modal groups in 1971 which has given a higher percentage composition for the fourth modal group (Fig. 8). As evident from the previous section, the success and failure of the fishery close to Ceylon appears to be dependant on the strength of the third modal group. The presently exploited range is a narrow belt and if further additions to the fleet are capable of covering a wider belt of the off shore range, the skipjack production could be stepped up considerably.

Oceanic Potential

It has been estimated that the Indian Ocean may be capable of yielding about four hundred thousand tons of skipjack per annum (Kikawa etal 1968). Presently about forty-five to fifty thousand tons of Skipjack are taken from this Ocean. Available information indicate that the Maldive islands is the largest contributor to this and is followed by Ceylon. The Laccadive and Minicoy islands probably contribute a little over one thousand tons. Information of skipjack production by other nations in the Indian Ocean, is not readily available. A very insignificant quantity may be taken by the tuna longliners operating in this Ocean.

An aerial survey conducted over the off shore range during June 1970 gave indication of surface schools in that range (Author 1971) but the catches during the same period indicated that there were greater subsurface resource than what was projected by the surface schools.

An attempt was made to determine the hooked rates for skipjack tuna caught incidentally during longline operation in the Indian Ocean. These values are not carefully entered in the fishing logs and the gear is not efficient for sampling this variety but some information on the distribution and guide lines for future studies, emerge from these result (Miyake 1968). The results of such a study are illustrated in figures 9 and 10. The relative density of distribution of skipjack appears to

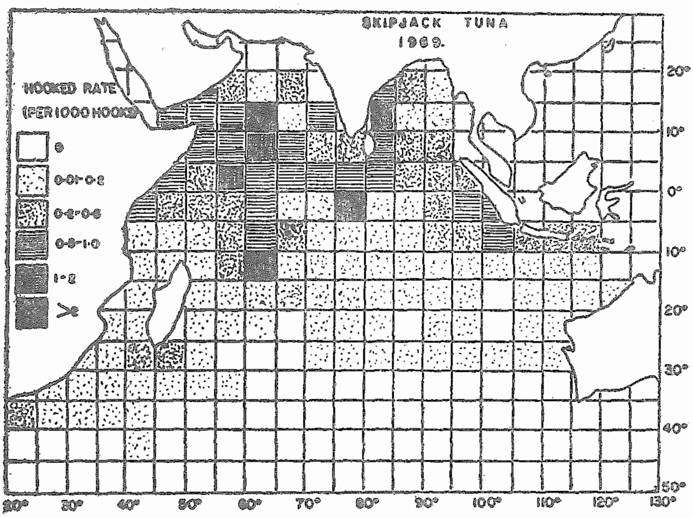


Fig. 9. Hooked rate (per 1000) of incidental catches of skipjack while longlining in the Indian Ocean (1969).

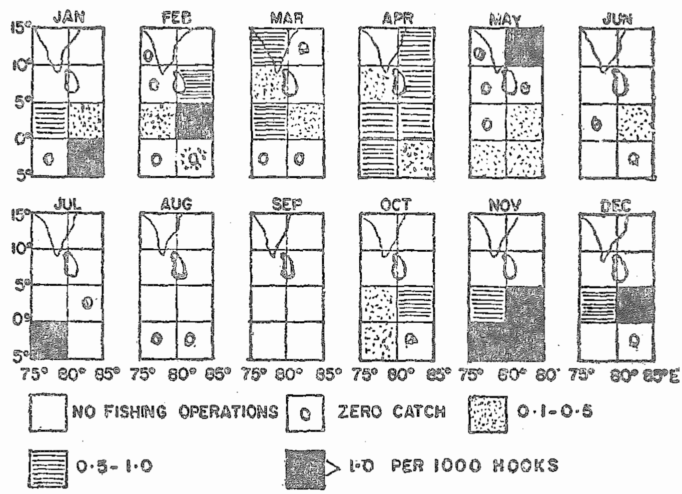


Fig. 10. Seasonal variation in the hooked rate of skipjack caught during longline operations in the Oceanic range close to Ceylon.

be greater in the Oceanic ranges West of Ceylon than in the Oceanic ranges in the east and also greater in the Northern half than in the Southern half. Seasonal variations in these values for the oceanic range close to Ceylon show that in 1969 relatively high hooked rates were realised between November

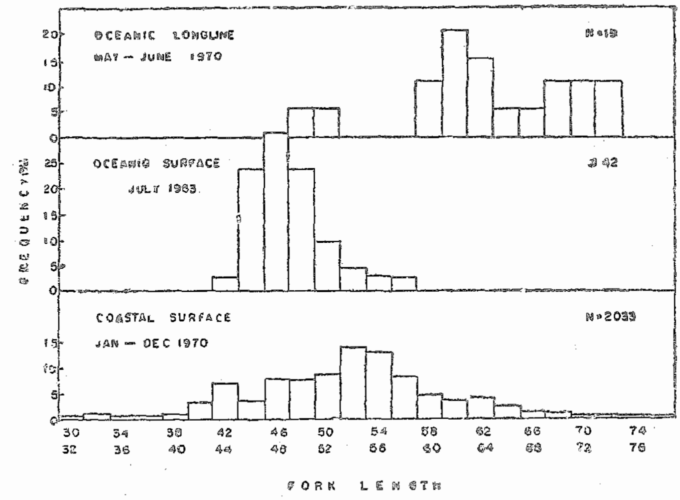


Fig. 11. Length frequency distributions of skipjack caught (a) close to Ceylon, (b) in the near oceanic surface waters and (c) during near oceanic longline operations

and February. The equatorial belt between 5°N and 5°S, directly south of Ceylon, appears to be an area of concentration. Longline operations in this area during June 1970 yielded a mean hooked rate of 0.8%. The skipjack caught were mostly the fourth and fifth modal groups (Fig. 11) and very few fish of the third modal group. Maldivian live bait vessel " Mullet ' conducted fishing in the oceanic range between Ceylon and Maldives, and unloaded the catch in Ceylon. The length frequency distri bution of a sample from their catch of June 1963 is also shown in the Figure 11.

These indirect evidences are indicative of the presence of skipjack resource in the Oceanic range around Ceylon particularly South and West of Ceylon. Further investigations, to be commenced this year, will determine the exploitable potential in this part of the Indian Ocean and the best method for exploiting it from Ceylon.

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